ATTO Technology, Inc.

ATTO ExpressStripe

Installation and Operation Manual

RAID for Mac OS X

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1 ATTO ExpressStripe Provides Storage Solutions

Congratulations on your choice of the premier volume creation and management application for the Macintosh® OS X operating system.

With its easy-to-use interface, ATTO ExpressStripe for Macintosh OS X gives you the power to optimize your storage without a complicated user interface. Whether using your Mac for high-end digital video editing, database management or other high performance applications, ExpressStripe for Mac OS X gives you the power you need to work more efficiently with volume creation and management.

Using a wizard-based interface, ExpressStripe for Mac OS X makes volume creation simple. By following a series of straight-forward steps, you can set up and begin to use your storage faster than ever.

ExpressStripe for Mac OS X provides RAID Level 0 functionality. Using this application, you can make several storage devices work together, making a larger virtual disk and taking advantage of the combined performance of those devices to match the needs of high-bandwidth applications.

This software package also includes the ATTO Benchmark tool. This user-friendly utility reports and graphs the peak, average and minimum read transfer rates.

If you need additional assistance, comprehensive on-line help text is available along the way. Click on the **help** button for additional information on the specific operation.

ExpressStripe highlights

- Creates Standard and RAID 0 volumes
- Support for volume sizes up to 8 exabytes
- support for multiple Macintosh OS X file system formats
- Creates multiple volumes simultaneously
- Supports SCSI, Fibre Channel, FireWire and ATA storage protocols
- Includes the ATTO Benchmark utility
- Wizard-style interface for easy setup
- Optimized for ATTO ExpressPCI and Celerity host adapters
- Striping interleave sizes of 4KB to 4MB allow application tuning
- Support for sector sizes greater than 512 Bytes
- Retrieves drive information
- Provides a visual representation of volumes, partition maps and system logs
- Provides integrated support to mount ATTO ExpressRAID for Mac OS 9 RAID Volumes, providing seamless support for legacy storage without costly, time-consuming data conversion
- Using the OS 9 Compatibility Extension available for download from the ATTO web site at www.attotech.com/software/drivers.html, mounts, reads from and writes to volumes created in ExpressStripe OS X
- Supports hot swap of drives attached to ATTO Celerity, ATTO ExpressPCI FC, ATTO ExpressPCI SCSI Ultra3 and ATTO ExpressPCI SCSI Ultra 320 adapters

System Requirements

- Mac OS X
- Attached storage and cables. For SCSI, SAS and Fibre Channel storage, we recommend an ATTO ExpressPCI SCSI, ExpressSAS SAS/SATA, ExpressPCI FC or Celerity FC Host adapter.
- Minimum one hard drive for volume creation; two hard drives for RAID compatibility in addition to the root drive.

2 RAID Overview

Originally Redundant Array of Inexpensive Disks, now Redundant Array of Independent Drives, RAID is a storage system using multiple disk drives. ATTO ExpressStripe creates virtual disk arrays on physical drives to increase capacity and performance.

Large amounts of data can be supported over many smaller drives when the drives are combined into one large “virtual” drive. Management is easier than using several drives in a JBOD (Just a Bunch of Disks) configuration.

RAID overlaps disk seeks, minimizing aggregate seek time delays for the storage group as a whole. Data is written in equal, short operations to each member of the RAID group in turn so that when the first member of a group begins writing to disk, the second member is available to take data. This continues until the last member of a group is writing to disk, and the first member of a group is ready for data.

RAID also takes advantage of the Macintosh OS ability to create partitions and volumes.

RAID Level 0

RAID Level 0 is commonly used when performance is more important than data-protection.

RAID Level 0, or striping, achieves higher I/O performance by breaking data into smaller units, then writing the data to separate physical drives. These striped volumes can then be read from the separate, physical drives, and re-assembled into the actual data with minimal delay. You must have at least two physical drives to create a striped volume

ATTO recommendations

- Although RAID 0 volumes can be created using different types and models of drives, use similar types/models to ensure the access time is equal to the average access time of a single drive rather than the access time for the slowest drive.
- For maximum performance, use a dual channel host adapter with drives equally distributed across busses.
- Use RAID 0 in environments that demand high I/O rates such as video production and editing, image editing and pre-press.
- Since RAID 0 does not provide fault tolerance, establish a backup policy to protect data stored on RAID 0 volumes.

3 Using ATTO ExpressStripe

Installing and getting around in ExpressStripe for Macintosh OS X is performed through a series of screens which lead you in the process of creating and managing storage groups.

Install ExpressStripe

1 Begin with either 1a or 1b, depending on how you received your ExpressStripe software:
   a. If you purchased ExpressStripe online and downloaded the files from the ATTO website, double-click the compressed file ***.tgz** and extract the contents to your desktop. The application installer ***.app** displays. Proceed to step 2.
   b. If you are installing ExpressStripe from a CD, locate the application auto-installer (***.app**) on the CD.

2 Double-click the auto-installer ***.app**.

3 Follow the on-screen prompts.

4 When prompted, reboot your computer to complete the installation.

5 Register your software online by following Web software authorization instructions on this page.

Note

The RAID driver is activated upon reboot.

Web software authorization

To start ExpressStripe for Mac OSX the first time, or when upgrading from earlier versions, you need the authorization code that was sent to you via Email. Please contact ATTO Technology Tech Support if you have not received this code.

The authorization code is generated from the ATTO Technology website.

1 On the Internet, go to software registration **www.attotech.com/license.html**

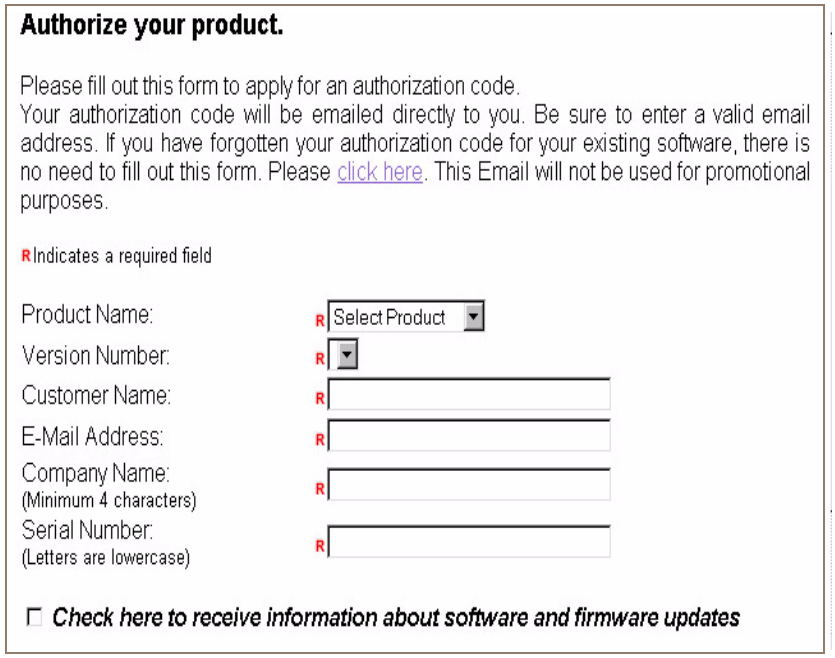
2 Select ExpressStripe and the current version number.

3 Type in your Email address, company name, and serial number (found on the ExpressStripe CD case).

Note

Your authorization code is sent to you via Email message.

4 Enter the authorization code when prompted to do so.


Authorize your product.
Please fill out this form to apply for an authorization code.
Your authorization code will be emailed directly to you. Be sure to enter a valid email address. If you have forgotten your authorization code for your existing software, there is no need to fill out this form. Please click here. This Email will not be used for promotional purposes.
R Indicates a required field
Product Name:
Select Product
Version Number:
Customer Name:
E-Mail Address:
Company Name:
(Minimum 4 characters)
Serial Number:
(Letters are lowercase)
Check here to receive information about software and firmware updates

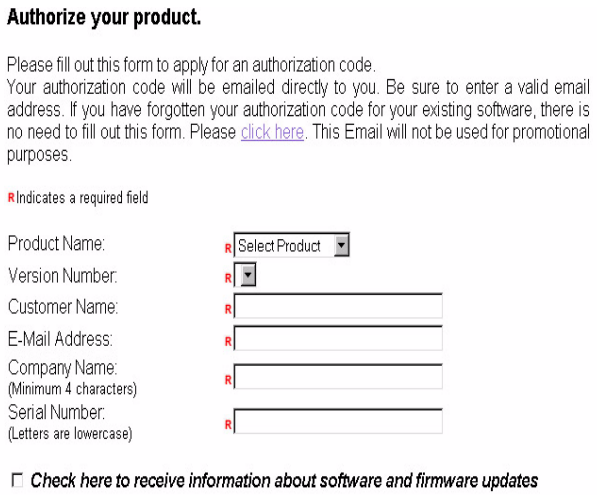
Quick start guide

If you are already familiar with partitions, volumes and RAID 0 configurations, ExpressStripe gives you easy access to information and configuration parameters.

Note

Close all other applications before using ExpressStripe.

- Click on the **Create** button to create a new Standard or RAID 0 volume.
- Click on the **Delete** button to delete a currently mounted Standard or RAID 0 volume.
- Click on the **Utilities** button, then the **Benchmark or Sys Info** buttons for detailed information about your storage.
- Click on the **Quit** button at the bottom of the screen to exit the application.
- Settings in the application are not persistent. If you make changes on one screen and then make changes on a previous screen (using the back button), the original screen is reset to the default settings.


Authorize your product.
Please fill out this form to apply for an authorization code.
Your authorization code will be emailed directly to you. Be sure to enter a valid email address. If you have forgotten your authorization code for your existing software, there is no need to fill out this form. Please click here. This Email will not be used for promotional purposes.
R Indicates a required field
Product Name:
Select Product
Version Number:
Customer Name:
E-Mail Address:
Company Name:
(Minimum 4 characters)
Serial Number:
(Letters are lowercase)
Check here to receive information about software and firmware updates

Error messages

The following generic error messages may be displayed during any operation. Error messages for specific operations may be found in those chapters.

Error: Could not unmount volumes.

Your system has not been changed.

The system did not unmount the volumes in time. You can drag the drives to the trash, and then try again. If the system can't unmount the drives because another program has them locked, an error message displays when you try to drag to the trash.

FileNotFoundException: /dev/[diskname] (device busy).

IOException: /dev/[diskname] (device busy)

IOException: /dev/[diskname] (not supported)

IOException: /dev/[diskname] (I/O Error)

Every operation needs to open the disk, and read from it or write to it. Sometimes the system prevents this process, such as when a volume is still mounted, and ExpressStripe displays a **FileNotFoundException** message.

IOException messages are usually read or write failures. If the device is unmounted (the device is not listed when the user types **df** in the terminal), then another program may have a lock on the disk. Quit the other programs, and/or reboot. Depending upon which operation failed, and in what part of the process, the disks may or may not have been changed.

NullPointerException

This may be caused by low memory.

4 Initializing Drives

Initializing a drive prepares a new drive for volume creation and erases all data on a disk.

To prepare a new drive or completely erase an old drive, you first initialize them using ATTO ExpressStripe.

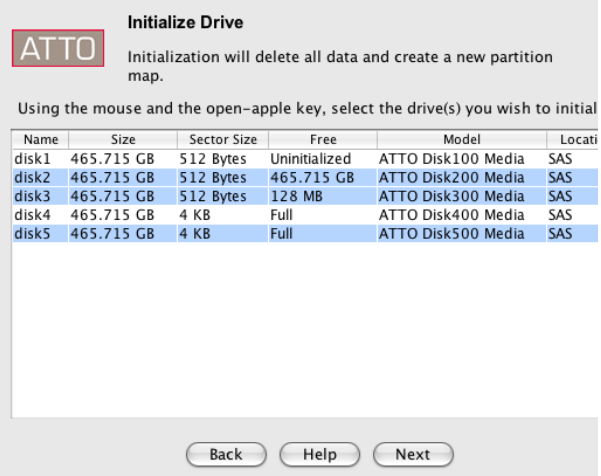
CAUTION

If you initialize a drive, all data on the initialized drive is permanently erased. Make a backup of any data on a drive before preparing it for volume creation.

1 On the opening screen, click on the *Delete* button.

2 Click on the **Initialize** button.

3 Using the mouse, highlight the drive to initialize. If you wish to initialize more than one drive, use the **shift** key to select consecutive drives or the **open-Apple** key to select specific, non-adjacent drives.


ATTO
Initialize Drive
Initialization will delete all data and create a new partition map.
Using the mouse and the open-apple key, select the drive(s) you wish to initial
Name Size Sector Size Free Model Locati
disk1 465.715 GB 512 Bytes Uninitialized ATTO Disk100 Media SAS
disk2 465.715 GB 512 Bytes 465.715 GB ATTO Disk200 Media SAS
disk3 465.715 GB 512 Bytes 128 MB ATTO Disk300 Media SAS
disk4 465.715 GB 4 KB Full ATTO Disk400 Media SAS
disk5 465.715 GB 4 KB Full ATTO Disk500 Media SAS
Back
Help
Next

4 Click the **Next** button.

5 Verify the parameters in the task list. If the parameters are incorrect, click on the *Back* button and return to the *Initialize Drive* selection screen without making any changes to your system.

6 If the parameters on the check list are acceptable, click the *Drive(s) Verified* button.

7 Click the *OK* button.

8 ATTO ExpressStripe for Mac OS X initializes the drive(s).

9 Click **Continue**.

Physical drive 4 in Exhibit 4.0-1 on the following page is a representation of what a drive looks like after being initialized.

Possible error messages

[diskname] was not initialized.

Each disk is tagged with this message before initialization. If this message appears, try the initialization process over again.

Initialized [diskname].

A success message: everything worked as expected.

FileNotFoundException.

Indicates either the empty partition map was not written out or the new partition map failed to reload.

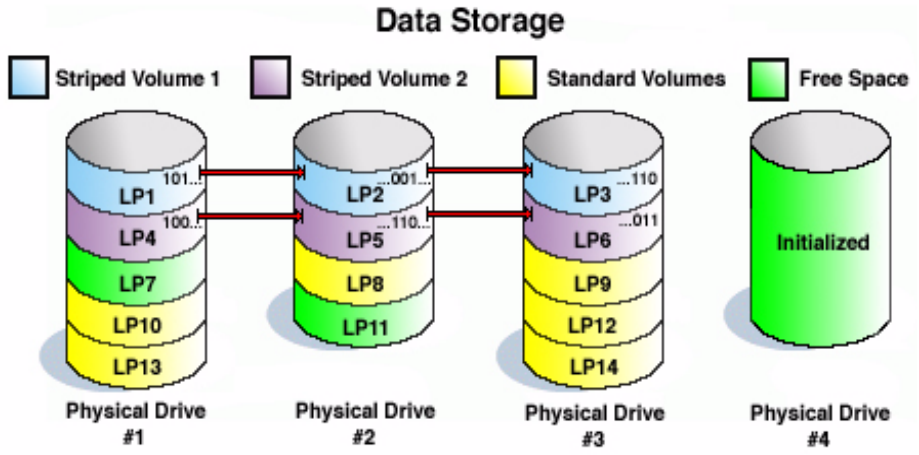
[IOExceptions]

IO exceptions can occur during Erase, Initialize Partition Map and Saving Partition Map operations.

[Initialization of [diskname] failed]

The error is written to the console log.

*Exhibit 4.0-1 Physical drive 4 is an initialized, empty drive ready for volume creation. **LP** denotes a logical partition of the physical drive.*



5 Creating a Standard Volume

ExpressStripe for MacOS X allows you to create Standard Volumes to store data on a single partition on a single physical drive.

A Standard Volume stores data on a single partition on a single physical drive.

The Express Stripe application creates one or more partitions with one or more Standard Volumes on a physical drive at the same time. The partition(s) can use the entire drive or may leave free space for use later.

Standard Volumes are convenient to create and use but are limited by the speed and size of the drive on which they are located.

Note

Standard Volumes do not offer any data recovery mechanism to restore lost data.

The ExpressStripe application can create one or more partitions with Standard Volumes on a physical drive. The partition(s) and volume(s) are created at the same time. The partition(s) can use the entire drive or they can leave free space that can be used later.

Note

*Click on the **Back** button at any time to go back one screen without making any changes on the current screen.*

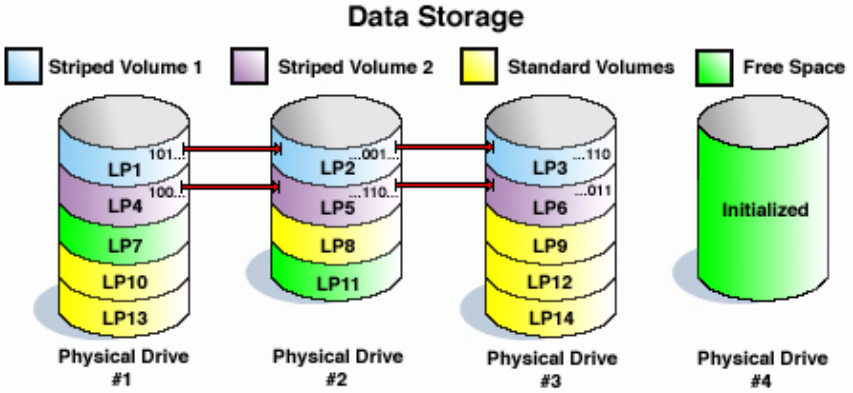
Example of data storage technology

Each cylinder represents a separate physical drive.

- Each physical drive has been divided into partitions, labelled logical partition (LP)
- Physical Drive 4 has been initialized and is empty with no partitions or data. It may be used to create a Standard or striped volume.
- LP7 and LP11 are free partitions that can be used to create Standard or striped volumes.
- Data has been striped (RAID Level 0) across physical drives 1, 2 and 3, using partitions LP1, LP 2 and LP3, named Volume 1. LP4, LP5 and LP6 are stripe data across three separate physical drives into Volume 2.
- LP8 is a Standard Volume using one partition.
- LP9, LP 10, LP12, LP 13 and LP14 are Standard Volumes.

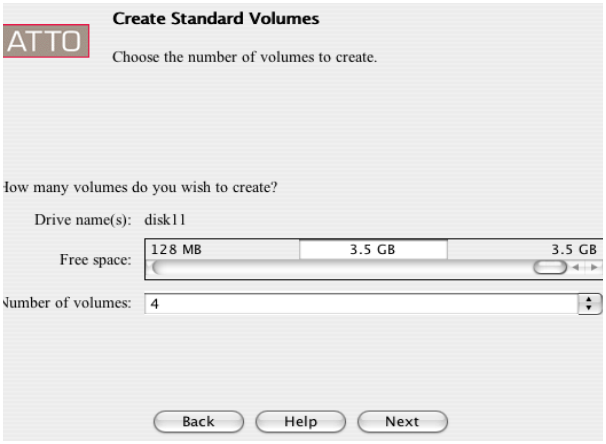
Note

If you create a striped volume across multiple physical drives and the partitions are not the same size, only the portion of each partition equal to the size of the smallest partition is used, leaving unused space on the larger partitions of the volume.

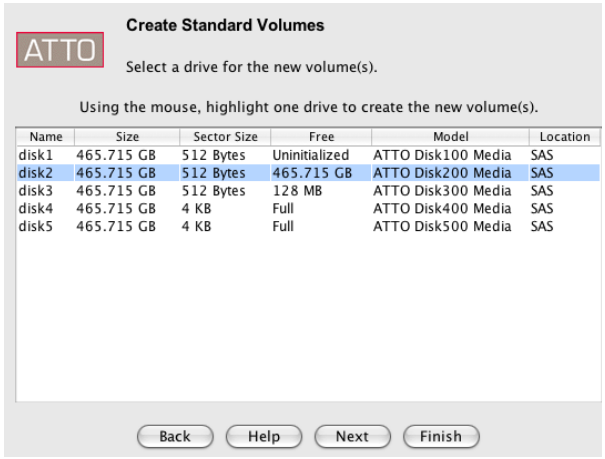


Create a single Standard Volume

1 From the **Create** screen, click on the **Standard** button.



2 Using the mouse, highlight the drive where you want the volume created.


ATTO
Create Standard Volumes
Select a drive for the new volume(s).
Using the mouse, highlight one drive to create the new volume(s).
Name Size Sector Size Free Model Location
disk1 465.715 GB 512 Bytes Uninitialized ATTO Disk100 Media SAS
disk2 465.715 GB 512 Bytes 465.715 GB ATTO Disk200 Media SAS
disk3 465.715 GB 512 Bytes 128 MB ATTO Disk300 Media SAS
disk4 465.715 GB 4 KB Full ATTO Disk400 Media SAS
disk5 465.715 GB 4 KB Full ATTO Disk500 Media SAS
Back
Help
Next
Finish

3 Click the **Next** button to continue the setup process and set volume parameters, such as size and number of volumes to be created, or click the **Finish** button to skip the setup process and create a new Standard Volume using common default parameters. The volume uses all the free space on the selected drive.

Note

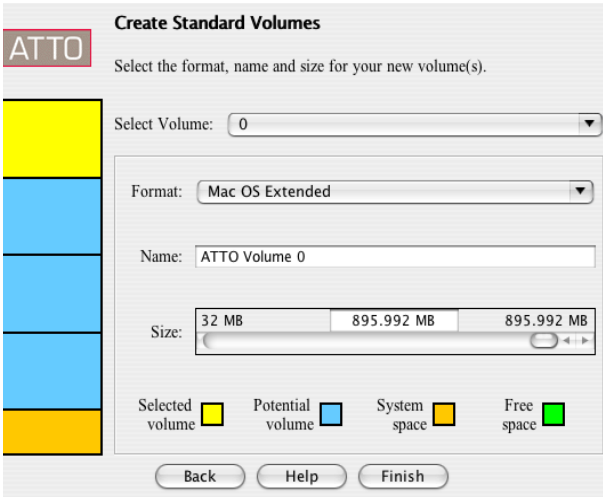
The number of volumes that can be created depends on the disk size and the free space remaining in the disk's partition map.

Create several Standard Volumes

ATTO ExpressStripe for MacOS X can simultaneously set up several Standard Volumes on a drive.

1 Verify that the **Drive name** matches the drive on which to create the new volume(s).

2 Use the **Free space** slider bar to choose the portion of the available free space that the new volume(s) occupies.



Note

*You may use the keyboard to enter the portion of free space, i.e. **xx MB, xx GB**.*

3 Using the **Number of volumes** pull-down list, select the number of Standard Volumes you wish to create from the selected free space.

4 Click on the **Next** button to configure the volumes.

Specify properties

For each Standard Volume created, you may specify properties such as format type, name and size.

1 Use the **Select Volume** list box to view the requested properties for a specific volume being created. The properties for that volume can then be modified.

2 Use the **Format** list box to select the format for the volume.

3 In the **Name** text field, enter a name for the volume.

4 Use the **Size** slider bar to adjust the size of the volume, if necessary.

Note

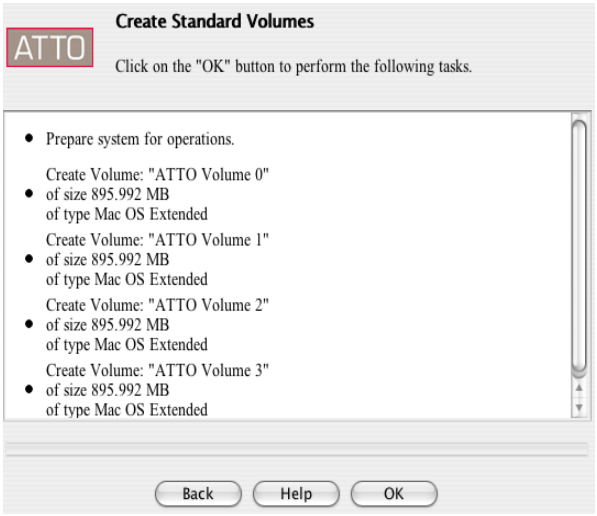
The graphical representation of the drive at the left of the screen helps you determine how much volume space has been allocated and how much free space remains.

5 Repeat this process for additional volumes.

6 Click on the **Finish** button.

7 Verify parameters before ATTO ExpressStripe for Mac OS X tries to create any volumes. Click on the **Back** button to return to the **Create Standard Volumes** number of volumes selection screen without making any changes to your system.

8 Click on the **OK** button to accept your settings and create a Standard Volume.


ATTO
Create Standard Volumes
Click on the "OK" button to perform the following tasks.
Prepare system for operations.
Create Volume: "ATTO Volume 0" of size 895.992 MB of type Mac OS Extended
Create Volume: "ATTO Volume 1" of size 895.992 MB of type Mac OS Extended
Create Volume: "ATTO Volume 2" of size 895.992 MB of type Mac OS Extended
Create Volume: "ATTO Volume 3" of size 895.992 MB of type Mac OS Extended
Back
Help
OK

Successful completion

When the process you have chosen is finished, a screen informs you which operations were completed or if requested operations were not completed.

Your desktop now shows the volumes you have created.

You may click **Quit** to end the program and use your new Standard Volume or click **Continue** to create more volumes.

An ExpresStripe Volume is represented on the desktop as an ATTO drive array and clipboard labelled either Fibre Channel, SAS or SCSI, denoting the type of attached drives.

Possible error messages

[VolumeName]: Partition was not created.
Each partition is tagged with this message before it has been manipulated. Reboot and try creating a volume again.

[Partition map is full.
You can create no more than 30 partitions per disk. The system has not been changed.

[VolumeName] was not formatted.
Each volume is tagged with this message after the partition map has been saved. The volume cannot be mounted but takes up space. You may mount the volume if you use **newfs** to lay down the proper format on the corresponding volume device.

[VolumeName] – could not format.
The program can't lay down the format on this volume. Other volumes may be formatted.

[VolumeName] created.
This is the success message; everything worked as expected.

[VolumeName]: BSD name does not exist.
If **IOKit** does not make the volume devices after the new partition map has been saved, there is nothing to format. Reboot and either **newfs** the proper volume device or initialize the entire drive.

FileNotFoundException or **IOException.**
Indicates that the partition map could not be saved which could occur after a partition map has been saved. No changes are made.

6 Creating a RAID 0 Volume

ExpressStripe for MacOS X allows you to create RAID Level 0 volumes.

RAID Level 0, or striping, achieves higher I/O performance by breaking data into smaller units, then writing the data to multiple, separate physical drives. These striped volumes can then be read from the spanned physical drives, and re-assembled into the actual data, with minimal delay.

The ExpressStripe application creates one or more RAID Volumes on partitions contained on two or more physical drives. The partition(s) and volume(s) are created at the same time. The partition(s) can use all the blocks on all of the drives or they can leave free space which can be used in the future.

Note

RAID Level 0 volumes do not offer any data recovery mechanisms to restore lost data. Back up data stored on RAID Level 0 volumes regularly.

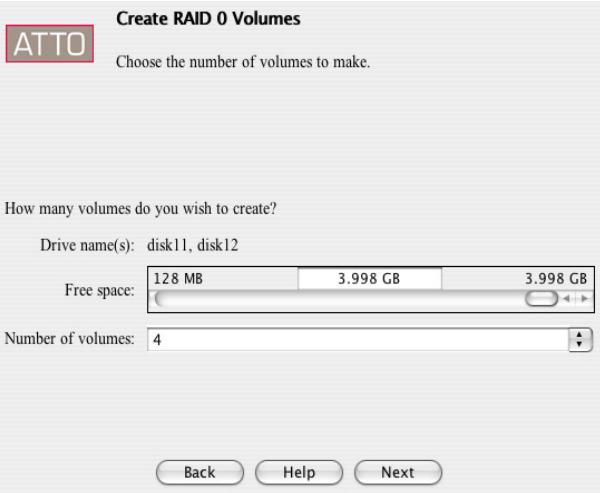
You must have at least two physical drives to create a striped volume.

Note

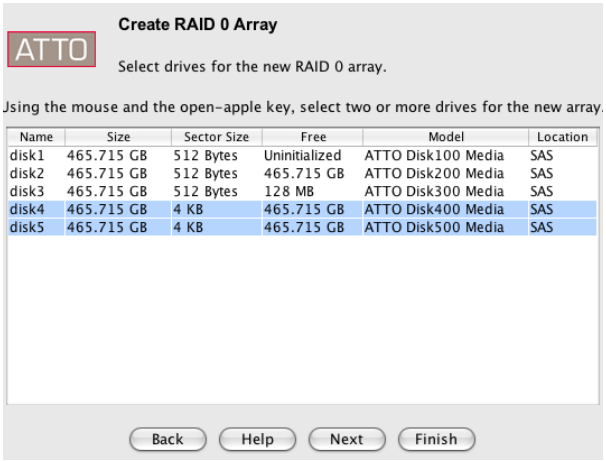
*Click on the **Back** button at any time to go back one screen without making any changes on the current screen*

Create a single RAID Volume

1 From the **Create** screen, click on the RAID 0 button.



2 Using the mouse, highlight the drives where you want the volume to be created.


ATTO
Create RAID 0 Array
Select drives for the new RAID 0 array.
Using the mouse and the open-apple key, select two or more drives for the new array.
Name Size Sector Size Free Model Location
disk1 465.715 GB 512 Bytes Uninitialized ATTO Disk100 Media SAS
disk2 465.715 GB 512 Bytes 465.715 GB ATTO Disk200 Media SAS
disk3 465.715 GB 512 Bytes 128 MB ATTO Disk300 Media SAS
disk4 465.715 GB 4 KB 465.715 GB ATTO Disk400 Media SAS
disk5 465.715 GB 4 KB 465.715 GB ATTO Disk500 Media SAS
Back
Help
Next
Finish

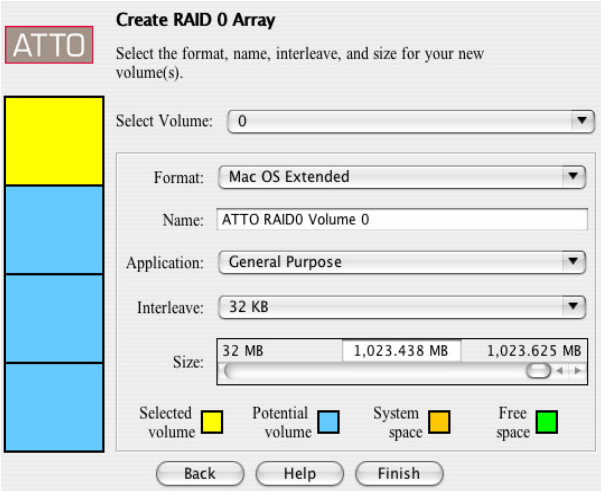
Note

All selected drives must have the same sector size. Drive sector size must be a factor of a supported interleave.

3 Click the **Next** button to continue the setup process and set volume parameters, such as size and number of volumes to be created, or click the **Finish** button to skip the setup process and create a new RAID 0 volume using common default parameters.

Note

Only valid options are shown. Interleave must be a product of sector size.



Create several RAID volumes

1 Verify that the Drive name matches the drive on which to create the new volumes.

2 Use the **Free space slider bar** to choose the portion of the available free space that the new volumes occupies.

Note

*You may use the keyboard to enter the portion of free space, i.e. **xx MB, xx GB**.*

3 Using the **Number of volumes** pull-down list, select the number of RAID 0 volumes you wish to create from the selected free space portion.

Note

The number of volumes that can be created depends on the disk free size and the space remaining in the disk's partition map.

4 Click on the **Next** button to configure the volumes.

Specify properties

For each RAID 0 volume being created, you may specify properties such as format type, name, interleave and volume size. Also available in ExpressStripe v2.0, or later, is one click optimization. This feature automatically detects and sets common properties based on the applications that you specify.

1 Use the **Select Volume** list box to view the requested properties for a specific volume being created. The properties for that volume can then be modified.

2 Use the **Format** list box to select the format of the volume.

3 In the **Name** text field, enter a name for the volume.

4 If you are using ExpressStripe v2.0, or later, select the appropriate application in the **Application** list box to automatically configure the RAID 0 volume properties for optimal performance. Use the Interleave list box only if you are using ExpressStripe version older than v2.0, or if your application vendor has recommended an interleave size different than that displayed.

5 Use the **Size** slider bar to adjust the size of the volume, if necessary.

Note

The graphical representation of the drive at the left of the screen displays how much volume

space has been allocated and how much free space remains.

6 Repeat the process for additional volumes.

7 Click on the **Finish** button.

8 Verify parameters before ATTO ExpressStripe for Mac OS X tries to create any volumes. Click on the **Back** button to return to the **Create RAID 0 Volumes** number of volumes selection screen without making any changes to your system.

9 Click on the **OK** button to accept your settings and create a RAID 0 volume.

Successful completion

When the process you have chosen is finished, a screen displays which operations were completed or if requested operations were not completed.

Your desktop shows the ATTO RAID 0 volumes you have created.

Click **Quit** to end the program and use your new RAID Level 0 volume or click **Continue** to create more volumes.

Note

ExpressStripe RAID 0 groups are represented on the desktop as an ATTO drive array and clipboard labelled ExpressStripe.

Possible error messages

[VolumeName]: Partitions were not created.
Each partition is tagged with this message before it has been manipulated. Look for the partition in the ExpressStripe **Utilities/Sys Info** partition map section. If a partition exists, use the **Initialize** function to erase the disk.

Partition map is full.
You can create no more than 30 partitions per disk The system has not been changed.

[VolumeName]: Partitions were not registered.
The partitions have been saved, but not yet registered. You can manually register them by running **ATTORAIDStamp**, and then **newfs**.

[VolumeName]: Could not register partitions.
ATTORAIDStamp has failed. Initialize the drives and try again.

[VolumeName]: Partitions registered.
Message the volume is tagged with after running the **ATTORAIDStamp**. Run **newfs** to make the volume usable.

[VolumeName] was not formatted.
Each volume is tagged with this message after the partition map has been saved. The volume is not mounted and takes up space. You may mount the volume if you use **newfs** to lay down the proper format on the proper disk.

[VolumeName] – could not format.
The program can't lay down the format on this volume. Other volumes may be formatted.

[VolumeName] created.
This is the success message; everything worked as expected.

[VolumeName]: BSD name does not exist.
If **IOKit** does not make the volume devices after the new partition map has been saved, there is nothing to format. Reboot and either **newfs** the proper volume device or initialize the entire drive.

[VolumeName] - is not alive!

Group Code: ATTO_XXXXXXXX
The object could not be found in the registry. Either the driver is not loaded or IOKit is unusable. Check to see if the driver is loaded.

- In Mac OS X 10.2.x or later, use the command

```
kextstat | grep -i attoraid
```

If the driver **ATTORAID_OS10.kext** is in **/System/Library/Extensions**, rebooting reloads it.

IOException.
May be generated by a RAID Stamp exec( ) failure or during a format or Partition Map Save operation.

7 Deleting a Volume

ExpressStripe for MacOS X allows you to delete volumes to reclaim space on your system.

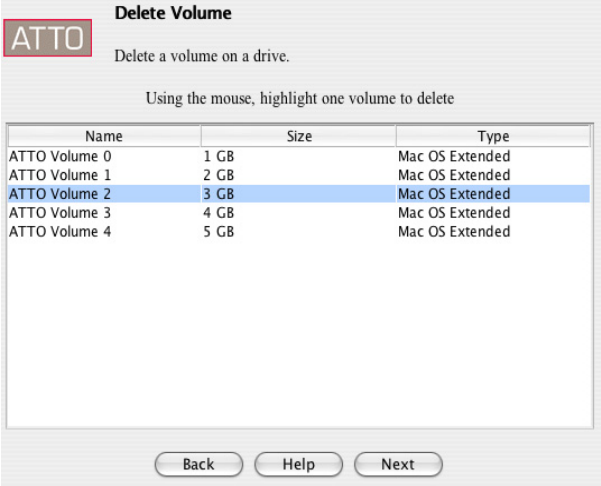
Deleting a volume from a drive frees up available space on your system. This free space can be made into one or more new volumes.

Note

All data on a deleted volume is permanently erased, and all associated partitions are deleted as well.

1 Click on the **Delete** button

2 Use the mouse to highlight the volume to delete.



Note

You may only delete one volume at a time.

3 Click on the **Next** button.

4 Verify parameters before ATTO ExpressStripe for Mac OS X tries to delete any volumes.

Note

*Click on the **Back** button to return to the **Delete** screen without making any changes to your system.*

5 Click the **OK** button if the parameters in the task list are acceptable.

6 ATTO ExpressStripe for Mac OS X deletes the volume.

7 Click **Quit** to end the program or **Continue** to delete or create volumes

Refer to Exhibit 7.0-1 to see the effect of deleting a volume.

Possible error messages

Volume [VolumeName] was not deleted.
Each volume is tagged with this message before manipulation. If you attempt to delete a volume and this message appears, try the process again.

UninitializedPartitionMapException.

A fatal error occurred while trying to erase [VolumeName].
You tried to delete a DOS volume or a volume on a disk without an Apple partition map structure. Do not try to delete DOS or other operating systems' volumes with ExpressStripe for Mac OSX. The system is unchanged.

Volume [VolumeName] was cleared, but not deleted.
Each volume is tagged with this message after the file system has been wiped but before the partition map has been saved. Volumes in this state are not mounted but take up space on the disk.

SystemCallException: Can't find volume [VolumeName].
The system didn't return the mount point. The filesystem has been destroyed and is unmountable. Reboot. *Newfs* the volume device or initialize the disk.

SystemCallException: ATTORAIDStamp... returned exit code X.
The tool that unregisters RAID partitions returned an error when you deleted a RAID Volume.

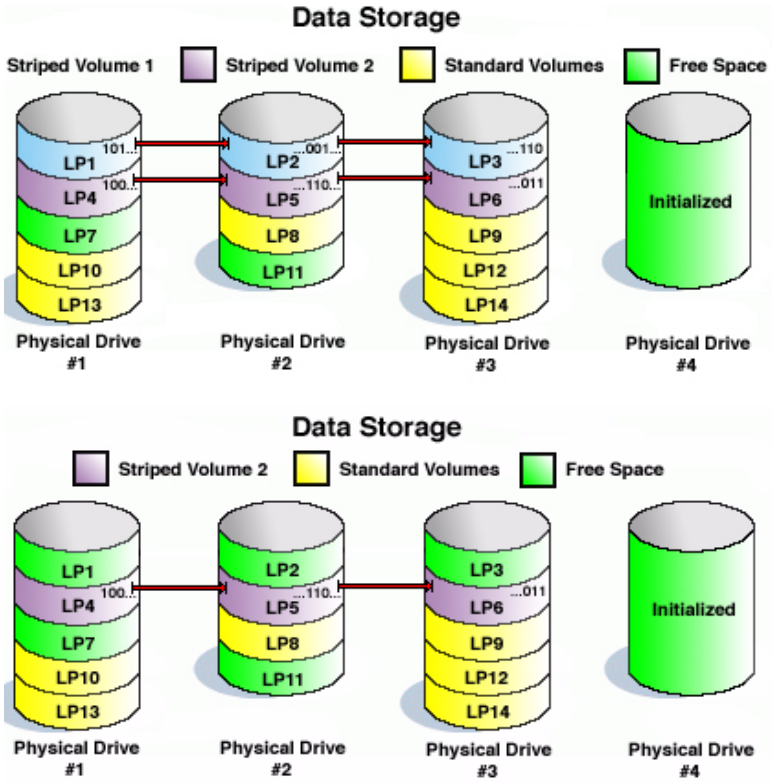
Volume [VolumeName] was deleted.
A success message; everything worked as expected.

FileNotFoundException or **IOException.**

8 Indicates the load of the old partition map or the save of the updated partition map failed. Wiping the filesystem may have also failed. Close the program with the lock on the disk, and/or reboot before trying again.

Exhibit 7.0-1 The effect of deleting a volume.The top figure in Exhibit 7.0-1 represents a storage configuration with LP1, LP2 and LP3 as striped volume 1. The diagram below shows the effect of deleting striped volume 1.

- Each cylinder represents a separate physical drive.
- Each physical drive has been divided into partitions, labelled logical partition (LP)
- If you delete Striped Volume 1, LP1, LP2 and LP3 becomes free space.You can create either Standard or RAID 0 volumes with ATTO ExpressStripe for Mac OS X with the freed space.
- All data on the deleted volume are permanently erased, and all associated partitions are also deleted.



8 System Information Utilities

ATTO ExpressStripe includes utilities to monitor system information and to benchmark drives, measuring peak and average throughput for disk reads.

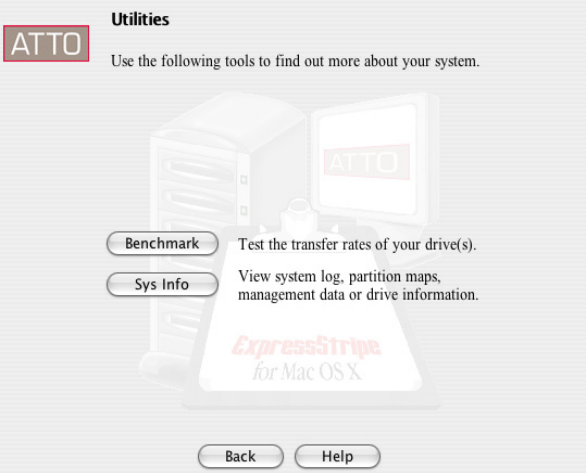
Click on the Utilities button from the main screen to access benchmark and system information utilities.

Benchmarking a Volume

ExpressStripe reports and graphs the read transfer rates on the drives being tested.

These benchmarks are non-destructive: they do not harm the data on volumes in any way.

1 Select **Benchmark** from the Utilities menu.


ATTO
Utilities
Use the following tools to find out more about your system.
Benchmark
Test the transfer rates of your drive(s).
Sys Info
View system log, partition maps, management data or drive information.
ExpressStripe for Mac OS X
Back
Help

2 Highlight a volume in the volume window.

3 Modify test parameters.

4 Click **Start**.

5 Benchmark results are displayed in an auto-scaling, easy-to-read graph.

Additional mounted volumes may be tested by selecting them from the volume menu of the benchmark utility.

Test parameters

Your benchmark results may be tuned using the following parameters.

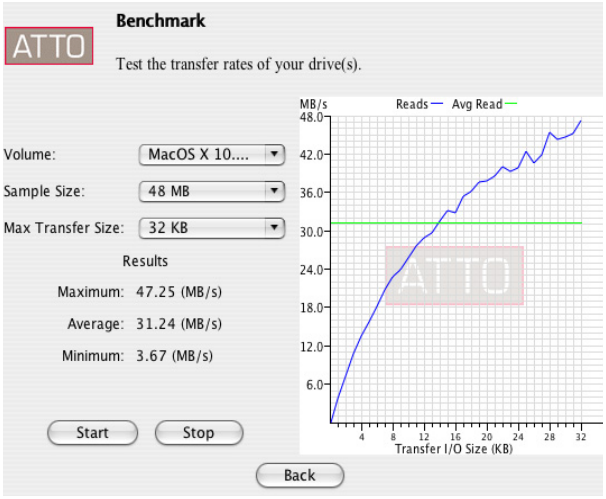
Max. Transfer Size

Choices: 32 KB, 128 KB, 512 KB, 2 MB, 8 MB

Default: 32 KB

The ExpressStripe Benchmark performs disk reads of varying sizes on the volume tested. The Max. Transfer Size option determines the size of the transfers.

To test a drive for applications which transfer smaller blocks of data, select a smaller value, such as 32 Kilobytes. To test a drive for applications which transfer larger blocks of data, select a larger transfer size.



Sample Size

Choices: 8, 16, 32, 48, 64, 80 MB

Default: 48 MB

Adjusting the sample size changes the number of times each transfer is done during the benchmark test. The transfers are then averaged for the final result. A larger sample size provides more accurate results, but causes the benchmark test to take longer.

Reading Benchmark results

Once the benchmark tests are completed, ExpressStripe graphically displays the average read transfer rate across all transfer sites tested. The Benchmark also reports the peak and minimum values of the read transfer rate test performed.

Average read value, shown as a flat line on the graph, indicates the true performance of the drive.

Peak value is also commonly referred to as the burst transfer rate.

To get a printout of your results, use the **open Apple-shift3** function.

System information

ExpressStripe reports different types of drive information based on your system and its configuration.

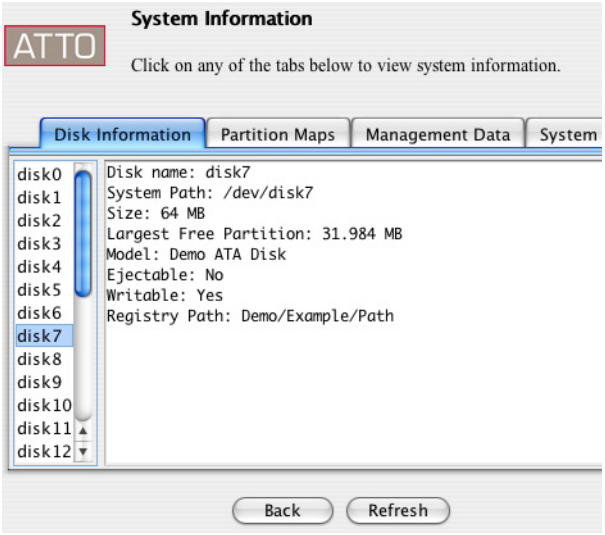
To return to the **Utilities Screen,** click on the **Back** button.

Disk Info provides general information about a disk retrieved from the system.

Partition Map is a visual layout of the partitions on the drive you select.

Management Data shows RAID configuration information

System Log reports recent ATTO activity for the last 10K of the system log.



Appendix A Glossary

Some common terms used in the storage industry are defined below. More information about Fibre Channel,SAS, SCSI and Storage Area Networks is available through the ATTO Technology website, www.attotech.com, the Fibre Channel Industry Association, www.fibrechannel.org, the SCSI Trade Association, www.scsita.org*, and the Storage Area Networking Industry Association, www.snia.org.*

Term	Definition
address	a specific location in memory
ANSI	American National Standards Institute
asynchronous	a way of sending data over a bus in which an initiator sending data does not wait for an acknowledgement (ACK) that the data has been received before sending more data. Refer to “synchronous”.
block	a sector of a disk which stores a group of bytes that must be read or written together.
case sensitive	a file system distinguishes between names which are the same but uses a different case for some or all of the letters.
CRC	Cyclic Redundancy Check: an error-correcting code which calculates a numeric value for received and transmitted data. If no error has occurred during transmission, the CRC for both received and transmitted data should be the same.
FC	Fibre Channel
firmware	software stored in read-only memory (ROM) or programmable ROM (PROM). Firmware is often responsible for a system’s behavior when it is first switched on.
full duplex	a communication protocol which allows transmission in both directions at the same time
half duplex	a communication protocol which allows transmission in both directions, but only one direction at a time
hierarchical file system	a file system commonly used on older Macintosh computers.
host	a processor, usually a CPU and memory, which communicates with devices over an interface
initiator device	a component which originates a command
JBOD	Just a Bunch Of Disks: a storage subsystem using multiple independent disk drives with or without RAID configuration.
journaling	feature which protects a file system’s integrity against power outages and other disruptive events. It does not protect the user data buffer at the time of failure.
LUN	Logical Unit Number: a SCSI or Fibre Channel identifier of a device
Mac OS X Extended	a hierarchical file system (HFS+) which supports longer file names and volumes than in older file systems.
Mac OS X Extended (Journaled)	an HFS+ file system with journaling capability
Mac OS X Extended (case sensitive)	an HFS+ file system with case sensitive capability
Mac OS X Extended (case sensitive, journaled)	an HFS+ file system with case sensitive and journaling capabilities
originator	an initiating device; a component which originates a command
partition	a logically separate portion of a disk used to allow multiple systems to coexist on a single disk drive.

Term	Definition
PCI	Peripheral Component Interconnect: a bus which allows devices to communicate with the CPU.
RAID	Originally Redundant Array of Inexpensive Disks, now Redundant Array of Independent Drives: a storage system spanning multiple disk drives.
	RAID Level 0: disk striping in which fixed-length sequences of data are mapped to member disks in a regular rotating pattern. Refer to “RAID Volume”.
RAID Volume	a volume created from two or more partitions which all reside on different drives.
receiver	the ultimate destination of data transmission; a terminal device
SAS	Serial Attached SCSI: a point-to-point serial architecture which offers higher throughput and better scalability than SCSI.
SATA	Serial ATA (Advanced Technology Attachment): a desktop-class storage interface using ATA drives for light-duty environments which offers faster data transfer, hot swapping, greater security and more reliable operation than parallel ATA.
SCSI	Small Computer Systems Interface: a processor-independent Standard for system-level interface between a computer and intelligent devices including hard disks, floppy disks, CD-ROM, printers, scanners, etc.
synchronous	a method of sending data over a bus in which an initiator sends data then waits for an acknowledgement (ACK) that the data has been received. Both the initiator and receiver must support synchronous mode. Refer to “asynchronous”.
Standard Volume	a volume created from a single partition which resides on a single drive.
target	a device which responds to commands by an initiator
topology	logical layout of the parts of a computer system or network and their interconnections
transfer rate	the rate at which bytes or bits are transferred, as in megabytes or gigabits per second.
volume	a usable quantity of storage managed by a file system composed of one or more partitions. The volume is formatted with the file system which manages the blocks within the volume. Refer to “Standard Volume”.

Appendix B Host Adapter Selection Guide

ATTO Technology offers a number of SCSI and Fibre Channel solutions for storage. The following charts compare the features of ATTO host adapters.

SAS/SATA: ExpressSAS and ExpressSAS RAID Adapters

	ExpressSAS Host Adapters			ExpressSAS RAID Adapters		
Product Features	**H308**	**H380**	**H30F**	**R348**	**R380**	**R30F**
Maximum transfer rate (full duplex)[1]	4.0 GB/sec.	4.0 GB/sec.	4.0 GB/sec.	4.0 GB/sec.	4.0 GB/sec.	4.0 GB/sec.
x8 PCI Express	✓	✓	✓	✓	✓	✓
Number of ports	8	8	16	8	8	16
Port configuration: external/internal	0/8	8/0	0/16	4/8 User selectable 4/4 or 0/8	8/0	0/16
Connector type	2 Mini SAS (x4) SFF 8087 internal	2 Mini SAS (x4) SFF 8088 external	4 Mini SAS (x4) SFF 8087 internal	1 Mini SAS (x4) SFF 8088 external 2 Mini SAS (x4) SFF 8087 internal	2 Mini SAS (x4) SFF 8088 external	4 Mini SAS (x4) SFF 8087 internal
Number devices supported	256 end-point	256 end-point	256 end-point	64 SAS/SATA targets 128 virtual	64 SAS/SATA targets 128 virtual	64 SAS/SATA targets 128 virtual
1.5 Gb SATA support	✓	✓	✓	✓	✓	✓
3 Gb SATA II support	✓	✓	✓	✓	✓	✓
3 Gb SAS support	✓	✓	✓	✓	✓	✓
Cable distances	Up to 8m SAS 1m SATA	Up to 8m SAS 1m SATA	Up to 8m SAS 1m SATA	Up to 8m SAS 1m SATA	Up to 8m SAS 1m SATA	Up to 8m SAS 1m SATA
Software RAID	0	0	0	0/40/50/60[2]	0/40/50/60[2]	0/40/50/60[2]
Integrated RAID				0/1/4/5/6[2]/10, JBOD DVRAID™	0/1/4/5/6[2]/10, JBOD DVRAID™	0/1/4/5/6[2]/10, JBOD DVRAID™
RAID management utility				✓	✓	✓
Global Hot Spares				✓	✓	✓
Event notification				Email, pop-up, log file	Email, pop-up, log file	Email, pop-up, log file
Memory (ECC)				256 MB standard	256 MB standard	512 MB standard
Advanced Data Streaming™	✓	✓	✓	✓	✓	✓
32/64-bit support	✓	✓	✓	✓	✓	✓
Windows	✓	✓	✓	✓	✓	✓
Linux (Red Hat, SUSE)	✓	✓	✓	✓	✓	✓
Mac OS X	✓	✓	✓	✓	✓	✓
RoHS compliant	✓	✓	✓	✓	✓	✓
Low profile	✓	✓	1/2 height	✓	✓	1/2 height

1 Performance ceiling is constrained by PCI Express bus transfer speed
2 Future support

Fibre Channel: Celerity 8-Gb

Product Features	FC-84EN	FC-82EN	FC-81EN
Fibre Channel Ports	4	2	1
FC protocol	8-Gb	8-Gb	8-Gb
Maximum Transfer Rate (half duplex)	3.2 GB/sec	1.6 GB/sec	800 MB/sec.
Maximum Transfer Rate (full duplex)	5 GB/sec	3.2 GB/sec	1.6 GB/sec.
Bus type	PCIe 2.0	PCIe 2.0	PCIe 2.0
Bus characteristics	8 lane	8 lane	4 lane
Optical interface	SFP+LC	SFP+LC	SFP LC
Maximum cable length	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb
Low profile form factor		✓	✓
Advanced Data Streaming (ADS™) Technology	✓	✓	✓
Software RAID support[1]	✓	✓	✓
Developer's kit (Target Mode & API)	✓	✓	✓
Windows support	✓	✓	✓
Linux (Red Hat, SUSE) driver support	✓	✓	✓
Macintosh OS X driver support	✓	✓	✓
RoHS Compliant	✓	✓	✓

3 ATTO ExpressStripe for OS X available; Express Power Center and other software RAID supported for Windows

Fibre Channel: Celerity 4-Gb

Product Features	FC-44ES	FC-42ES	FC-41ES/EL	FC-42XS	FC-41XS
Fibre Channel Ports	4	2	1	2	1
FC protocol	4-Gb	4-Gb	4-Gb	4-Gb	4-Gb
Maximum Transfer Rate (half duplex)	1.6 GB/sec	800 MB/sec	400 MB/sec.	800 MB/sec	400 MB/sec
Maximum Transfer Rate (full duplex)	2 GB/sec	1 GB/sec	800 MB/sec.	1 GB/sec[1]	800 MB/sec
Bus type	PCIe	PCIe	PCIe	PCI-X	PCI-X
Bus characteristics	8 lane	4 lane	4 lane	64-bit 133 MHz[2]	64-bit 133 MHz[2]
Optical interface	SFP LC	SFP LC	SFP LC	SFP LC	SFP LC
Maximum cable length	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb
Low profile form factor		✓	✓	✓	✓
Advanced Data Streaming (ADS™) Technology	✓	✓	✓	✓	✓
Software RAID support[3]	✓	✓	✓	✓	✓
Developer's kit (Target Mode & API)	✓	✓	ES only	✓	✓
Windows support	✓	✓	✓	✓	✓
Linux (Red Hat, SUSE) driver support	✓	✓	✓	✓	✓
Macintosh OS X driver support	✓	✓	✓	✓	✓
Novell Netware	✓	✓	ES only	✓	✓
Solaris	✓	✓	ES only	✓	✓
Free BSD	✓	✓	ES only	✓	✓
RoHS Compliant	✓	✓	✓	✓	✓

1 Performance ceiling is constrained by bus transfer speed
2 Backward compatible to 32-bit and 33 MHz PCI
3 ATTO ExpressStripe for OS X available; Express Power Center and other software RAID supported for Windows

Fibre Channel: ExpressPCI 2-Gb

Product Features	FC 3300
Maximum Transfer Rate (MB/sec.)	400
32-bit PCI compatible	✓
64-bit PCI compatible	✓
Fabric & loop support	✓
Number of FC channels	1
Cable distances	500m@1-Gb 300m@2-Gb
33 MHz PCI compatible	✓
66 MHz PCI compatible	✓
Optical/copper interface	Fixed SW LC
Class	2.3
Full duplex	✓
RAID support	✓
Windows XP/NT/2000/95/98 support	✓
Solaris	✓
Mac OS 9 & OS X support	✓

SCSI: ExpressPCI Ultra320 SCSI

Product Features	UL5D	UL5D LP	UL4D	UL4S
Maximum Transfer Rate (MB/sec.)	640	640	640	320
Low Voltage Differential	✓	✓	✓	✓
Single-ended SCSI	✓	✓	✓	✓
Number of SCSI channels	2	2	2	1
Connector config. external/internal	2/2	2/0	2/2	1/1
Number of SCSI IDs supported	30	30	30	30
Cable distances (m)	12.5	12.5	12.5	12.5
Large File Transfers	✓	✓	✓	✓
32-bit PCI compatible			✓	✓
64-bit PCI compatible			✓	✓
33 MHz PCI			✓	✓
66 MHz PCI			✓	✓
133 MHz PCI-X			✓	✓
x4 PCI Express	✓	✓		
Windows support	✓	✓	✓	✓
Linux	✓	✓	✓	✓
Mac OS X support	✓	✓	✓	✓
Novell Network support	✓	✓	✓	✓
RoHS compliant version	✓	✓	✓	✓
Low profile		✓		